REMOTE KEY TURNING TOOL AND METHOD FOR USING THE SAME

Related Application(s)

The present application is a continuation of and claims priority from U.S. Patent Application Serial No. 10/301,216, filed November 21, 2002.

Field of the Invention

The present invention relates to tools and, more particularly, to a tool for remotely turning a key.

Background of the Invention

When servicing automobiles and the like, it is often necessary or desirable to turn the ignition switch of the automobile, via the ignition key, to and between the "on", "off" or "start" positions. In particular, a mechanic may wish to change the position of the ignition switch while located remotely from the ignition switch, for example, under the automobile or in or adjacent the engine bay of the automobile. Frequently, a second person is not available to operate the ignition switch or it is inconvenient or impractical for even a second person to operate the switch (e.g., the automobile is raised on a lift). Thus, the mechanic must move back and forth between the ignition switch and the area of the automobile to be serviced or observed.

Summary of the Invention

According to embodiments of the present invention, a tool for remotely turning a key includes a key unit including an engagement assembly adapted to engage the key and an operator unit including a control assembly. At least one cable segment is provided linking the key unit and the operator unit such that the engagement assembly can be mechanically rotated via the cable segment by manipulation of the control assembly to thereby rotate the key when the key is engaged by the engagement assembly.

The cable segment may be pulled when the control member is operated to rotate the engagement assembly.

The key unit includes a key unit housing, the engagement assembly being rotatably mounted in the key unit housing. The operator unit includes an operator unit housing, the control assembly being mounted in the operator unit housing.

A clutch mechanism may be adapted to limit the load applied to the key by the tool.

According to method embodiments of the present invention, a method for remotely turning a key includes providing a tool including a key unit including an engagement assembly adapted to engage the key. An operator unit including a control assembly is also provided. At least one cable segment is provided linking the key unit and the operator unit such that the engagement assembly can be mechanically rotated via the cable segment by manipulation of the control assembly. The engagement assembly is mounted on the key, and thereafter the key is turned by manipulating the control assembly to mechanically rotate the engagement assembly via the cable segment.

Objects of the present invention will be appreciated by those of ordinary skill in the art from a reading of the figures and the detailed description of the preferred embodiments which follow, such description being merely illustrative of the present invention.

Brief Description of the Drawings

Figure 1 is a perspective, fragmentary view of a remote key turning tool according to embodiments of the present invention;

Figure 2 is a perspective view of an operator using the tool of **Figure 1** to control the ignition switch of an automobile on a lift;

Figure 3 is an elevational, fragmentary view of a key unit of the tool of **Figure 1** mounted on an ignition key, the key being mounted in an ignition assembly of the automobile of **Figure 2**;

Figure 4 is a cross-sectional view of the key unit of **Figure 3** taken along the line **4-4** of **Figure 1** and mounted on the key;

Figure 5 is a rear, plan, fragmentary view of the key unit with portions thereof removed or sectioned for clarity;

Figure 6 is a cross-sectional view of an operator unit of the tool of **Figure 1** taken along the line **6-6** of **Figure 1**; and

Figure 7 is a front, plan, fragmentary view of the operator unit with portions thereof removed or sectioned for clarity.

Detailed Description of the Preferred Embodiments

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, the relative sizes of regions may be exaggerated for clarity.

With reference to **Figures 1** and **2**, a remote key turning tool **10** according to embodiments of the present invention is shown therein. The tool **10** includes a key unit **100**, an operator unit **200**, and a cable system **12**. The cable system **12** includes a cable assembly **30** and a cable assembly **40**. The key unit **100** includes an engagement assembly **101** adapted to engage and turn an automobile key **8** (**Figure 3**) or the like. The operator unit **200** includes a control assembly **201** which can be manipulated (via a knob **268**) by an operator **4** to rotate the engagement assembly **101**. The engagement assembly **101** and the control assembly **201** are operably linked or connected by the cable assemblies **30**, **40**.

Referring to **Figures 2** and **3**, an exemplary use for the tool **10** is shown therein. An automobile **2** is raised on a lift **3**. The key unit **100** is engaged with the key **8** of the ignition assembly **6** of the automobile **2**. The operator **4** is holding the operator unit **200** below the automobile **2** and the cable system **12** extends through the window of the automobile **2**. In this manner, the operator **4**, while servicing or observing the underside of the automobile **2** (e.g., to repair or diagnose an undermounted fuel pump), may turn the ignition assembly **6** to the "on", "off" or "start" positions as needed.

Turning to the key unit **100** in greater detail and with reference to **Figures 3-5**, the key unit **100** includes a housing **102**. The housing **102** has housing parts **110** and **120** (housing part **110** is omitted from **Figure 5**). The housing **102** is preferably sized and shaped such that it can be conveniently and effectively handheld. Preferably, the housing **102** is no more than twelve inches long. The housing parts **110** and **120** are joined by screws **5** (**Figure 1**). An opening **112** (**Figures 1** and **4**) is formed in the housing part **110**. An opening **122** (**Figure 4**), a bore **124** (**Figures 4** and **5**) and a pair of channels **130**, **132** (**Figures 4** and **5**) are formed in the housing part **120**. The channels **130**, **132** communicate with the bore **124** and respective end openings **130B**, **132B**. The channels **130**, **132** have respective enlarged portions **130A**, **132A** adjacent the openings **130B**, **132B**. The housing parts **110**, **120** may be formed of any suitable material, and are preferably formed of metal, more preferably aluminum.

An optional counterweight/handle rod **104** extends from the housing **104**. The counterweight/handle rod **104** may be formed of any suitable material such as steel or lead.

The engagement assembly **101** includes a head member **140** (not shown in **Figure 5**) extending through the opening **122** and a base member **160** extending through the opening **112** and into the bore **124**. The base member **160** includes a cylindrical shaft portion **163**. The members **140** and **160** are joined by screws **5** (only one of which is shown in **Figure 4**). The members **140**, **160** are preferably formed of metal, more preferably aluminum.

A bearing assembly **150**, preferably a ball bearing assembly as shown, is mounted in the bore **124**. The bearing assembly **150** includes an outer race **154** fixedly mounted with respect to the housing part **120** by a circlip **156**, which is

received in a groove **126** in the housing part **120**. Balls **153** are captured between the outer race **154** and the inner, rotatable race **152**. The head member **140** and the base member **160** are secured (e.g., via friction fit, adhesive, welding or suitable fastener(s)) to the inner race **152** for rotation therewith.

The head member **140** has a slot **142** defined therein and adapted to receive the key **8**. The head member **140** also defines a passage **144** communicating with the slot **142** as well as a passage **164** defined in the base member **160**. A pair of clamp arms **170** extend through the passages **144**, **164**. Each clamp arm **170** has a jaw portion **172** and a lever portion **174** and is pivotable with respect to the head member **140** about a respective pivot pin **176**. A spring **178** biases the jaws **172** into a closed (i.e., converged) position to securely grip the key **8**. The jaws **172** can be opened to receive or release the key **8** by pressing the lever portions **174** toward one another. Alternatively or additionally, set screws **141** extending laterally through the head member **140** may be screwed into the slot **142** to grasp the key **8**. The head member **140**, clamp arms **170**, pivot pins **176**, spring **178**, and set screws **141** are removed from the unit **100** in **Figure 5** for clarity.

Turning to the operator unit **200** in more detail and with reference to **Figures 1**, **6** and **7**, the operator unit **200** includes a housing **202** (**Figure 1**). The housing **202** includes housing parts **210** and **220**. The housing **202** is preferably sized and shaped such that it can be conveniently and effectively handheld. Preferably, the housing **202** is no more than twelve inches long. The housing parts **210** and **220** are joined by screws **5** (**Figure 1**). An opening **212** (**Figure 6**) is formed in the housing part **210**. An opening **222** (**Figure 6**), a bore **224** (**Figures 6** and **7**), and a pair of channels **230**, **232** (**Figures 6** and **7**) are formed in the housing part **220**. The channels **230**, **232** communicate with the bore **224** and respective end openings **230B**, **232B**. The channels **230**, **232** have respective enlarged portions **230A**, **232A** adjacent the openings **230B**, **232B**. The housing parts **210**, **220** may be formed of the same suitable and preferred materials as described above with regard to the housing parts **110**, **120**.

The control assembly **201** includes a base member **240** extending through the opening **222** and a face member **260** extending through the opening **212** and into the bore **224**. The face member **260** includes a cylindrical shaft portion **243**. The members **240**, **260** are joined by screws (only one shown in **Figure 6**). The

members **240**, **260** are preferably formed of metal, more preferably aluminum. The face member **260** and the knob **268** are removed from the unit **200** in **Figure 6** for clarity.

A bearing assembly **250**, preferably corresponding to the bearing assembly **150**, is mounted in the bore **224**. The outer race **254** is fixedly mounted with respect to the housing part **220** by a circlip **256** which is received in a groove **226** in the housing part **220**. The balls **253** are captured between the outer race **254** and the inner, rotatable race **252**. The base member **240** is secured (e.g., via friction fit, adhesive, welding or suitable fastener(s)) to the inner race **252** for rotation therewith. The ergonomic knob **268** is affixed to the face member **260** by a screw **5** such that the knob **268**, the base member **240**, the face member **260** and the inner race **252** are rotatable as a unit relative to the housing **202**.

Turning to the cable system **12** in more detail and with reference to **Figures 5** and **7**, the cable assemblies **30**, **40** are preferably of multi-layer construction as shown and described below. The cable assemblies **30**, **40** are sectioned in **Figures 5** and **7** for the purpose of explanation. One or more bands **76** (**Figure 1**) may be provided to hold the cable assemblies **30**, **40** together. The cable assembly **30** includes a cable segment **32**, a spacer sheath **34** and a cover sheath **36**. The cable segment **32**, the sheath **34** and the sheath **36** are each flexible. The cable segment **32** is preferably formed of multiple, twisted metal wires, but may be formed of any suitable material and construction (e.g., string). Preferably, the spacer sheath **34** defines a passage through which the cable segment **32** can freely slide. Preferably, the passage of the spacer sheath **34** is radially rigid to prevent or resist collapse of the passage. The spacer sheath **34**, while being laterally flexible, is preferably substantially longitudinally fixed or incompressible. Preferably, the spacer sheath is formed of a wound metal wire. Preferably, the spacer sheath **34** has a length of at least 5 feet, more preferably of between about 8 and 16 feet, and most preferably of between about 10 and 11 feet. The cover sheath **36** is preferably formed of a flexible polymeric material, more preferably a plastic or rubber covering, to protect surfaces (e.g., the automobile) from damage. The cable assembly **40** includes a cable segment **42**, a spacer sheath **44** and a cover sheath **46** corresponding to the cable segment **32**, the sheath **34** and the sheath **36**, respectively.

The cable segments **32** and **42** extend through the openings **130B** and **132B** and the channels **130** and **132**, respectively, of the key unit **100** as shown in **Figure 5**. A cable loop segment **50** connects the cable segments **32**, **42** to one another. The cable loop segment **50** includes a plurality of loops **52** as shown in **Figure 4** wound or helically wrapped about the shaft portion **163**. Preferably, as discussed below, the loops **52** are not fastened to the shaft portion **163** or the engagement assembly **101**.

Rigid grommets **70** are provided having reduced portions **70A** mounted in the enlarged channel portions **130A**, **132A** of the housing part **120**. Enlarged portions **70B** receive the ends **34A**, **44A** of the spacer sheaths **34**, **44** as well as the cable segments **32**, **42**. In this manner, the sheaths **34**, **44** are braced against the housing **102**.

The cable assemblies **30**, **40** are similarly connected to the operator unit **200**. More particularly, the cable segments **32**, **42** extend through the grommets **70** (which also receive the remaining ends **34A**, **44A** of the spacer sheaths **34**, **44** to thereby brace the sheaths **34**, **44** against the housing **202**) and through the channels **230** and **232**, respectively. A cable loop segment **60** joins the cable segments **32**, **42** and includes a plurality of loops **62** as shown in **Figure 6**. One of the loops **62** is fixedly captured between a screw **243** and a spacer **7** in a recess **242B** of the base member **240**.

An in-line spring **82** is positioned in the cable segment **42** in the channel **232** such that, when a prescribed tension in the cable segment **42** is exceeded, the spring **82** will stretch. The spring is preferably selected such that it is partially stretched to maintain a moderate tension in the cable segment **42** during normal operation. A clip or limiting wire loop (e.g., of wire or the like) **84** extends through and about the spring **82** to limit the ultimate extension of the spring **82**.

The cable system **12** operatively connects the engagement assembly **101** and the control assembly **201** as follows. When the knob **268** and thus the member **240** are rotated in a clockwise direction **A** (**Figure 7**) relative to the housing **202**, a portion of the cable segment **32** is pulled into the housing **202**. The spacer sheath **34** serves as a spacer between the housings **102** and **202** so that the cable segment **32** is correspondingly pulled out of the housing **102**. As a result, the cable segment **32**, via the frictional engagement between the loop segment **50** and the shaft

portion **163**, rotates the member **140** in a clockwise direction **B** (**Figure 5**) relative to the housing **102**. Likewise, rotation of the knob **268** in a counterclockwise direction **C** (**Figure 7**) relative to the housing **202** pulls the cable segment **42** into the housing **202** and out of the housing **102**, thereby rotating the member **160** in a counterclockwise direction **D** (**Figure 5**) relative to the housing **102**. In addition to the pulling forces, the rotation of the member **160** may be enabled or facilitated by the pushing of the other cable segment **32** or **42**.

Preferably, and as shown, the cable segments **32**, **42**, **50** and **60** each form a part of a continuous common cable **12A** (**Figures 5** and **7**). It will be appreciated from the foregoing description that, while the cable segments **32**, **42** and the cable loop segments **50**, **60** are identified in the described and illustrated embodiments, they translate or shift from one category to another as the tool **10** is operated. That is, as the knob **268** is rotated in the direction **A**, a portion of the loop segment **60** will become part of the cable segment **30**, a portion of the cable segment **32** will become part of the loop segment **50**, a portion of the loop segment **50** will become part of the cable segment **42**, and a portion of the cable segment **42** will become part of the loop segment **60**. When the knob **268** is rotated in the opposite direction, the reverse shifting will occur. The cable **12A** may be continuously formed or may include a plurality of separate cable segments joined (e.g., by splicing, clamping, welding or the like) to form a continuous, fabricated cable.

The loop segment **50** and the shaft portion **163** may cooperate to serve as a clutch or torque transfer limiting mechanism. That is, because the loop segment **50** is not fastened to the engagement assembly **101**, up to a certain tension in either cable segment **32**, **42** the loop segment **50** will grip or frictionally hold the shaft portion **163** to exert rotational force on the engagement assembly **101**. However, once a prescribed rotational force is exceeded, the loop segment **50** will slip relative to the shaft portion **163**, thereby effectively preventing a deliberate or inadvertent excessive rotational force or cable tension that may damage the key **8**, the automobile **2**, or the tool **10**.

The tool **10** may be used by mounting the key unit **100** on the key **8** as discussed above and as illustrated in **Figure 3**, for example. The cable system **12** is routed to a remote location. The operator may then rotate the key **8** in either direction in the manner described above by rotating the knob **268** in the

corresponding direction relative to the housing **202**. The weight of the non-rotated parts of the key unit **101** (i.e., the portions of the key unit **101** other than engagement assembly **101**) counteract the rotation of the engagement assembly **101** so that the rotational driving force of the engagement assembly **101** is directed to the key **8**. Preferably, the key unit (including the counterweight **104**) other than the engagement assembly **101** weighs at least 0.75 pound, more preferably at least 1.25 pounds, and most preferably between about 1.5 and 2.5 pounds. The counterweight/handle rod **104** (**Figure 1**) may be used to stabilize the unit **100**. A magnet **204** may be affixed to the housing **202** for temporarily securing the unit **200** to a suitable metal surface or object (e.g., automobile hood or underside, lift, etc.).

The tool **10** may provide a number of advantages. The tool **10** is simple and convenient to use. Because rotation in each direction is effected by pulling one of the cable segments **32**, **42**, the tool **10** may allow precise and sensitive control of the key **8**. The tool **10** may provide high durability. The cable assemblies **30**, **40** may be of substantially any suitable length while nonetheless maintaining consistent and positive control.

The tool **10** may be further provided with cable tension adjustment means. For example, the grommets **70** may be threaded into the housing parts **102**, **202** such that the distance between the housings **120**, **220** can be adjusted by screwing the grommets **70** in or out.

The tool **10** may be further provided with an electrical jumper extending from the key unit **100** to the operator unit **200**. The key unit **100** may include an electrical connector adapted to engage an automobile cigarette lighter socket or other power connector, for example, thereby allowing the operator to source or test the power provided at the socket.

Other structures or components to grasp the key **8** with the engagement assembly **101** may be provided. Moreover, the head member **140** and other portions of the engagement assembly **101** may be adapted to be removed and replaced with such other components. For example, the head member **140** may be interchangeable such that it can be replaced with a replacement head member that is differently configured. The replacement head member may be adapted to hold

the key **8** in a different manner and/or may be adapted to grasp a key of a different configuration and/or size than the key **8**.

The tool **10** may be modified to eliminate one or both of the cable loop segments **50**, **60**. For example, the ends of the cable segments **32**, **42** may be anchored (e.g., with fasteners, welds, or adhesive) to the shaft portions **163**, **243** such that the cable segments are pushed or pulled in the manner described above as the assemblies **101**, **201** are rotated.

The control assembly **201** may be replaced with other components to pull the cable segments **32**, **42**, such as a lever and pulleys suitably arranged.

The cable **12A** may be replaced with multiple, separate cables. "Cable segment" as used herein does not require that the cable including the cable segment include any further cable portion or segment. That is, the referenced cable segment may constitute the entirety of a cable.

The control assembly **101** and the engagement assembly **201** as discussed above each include multiple, joined components. However, the assemblies **101**, **201** may each be formed of fewer components and may even be unitarily formed in accordance with embodiments of the present invention. "Control assembly" and "engagement assembly" as used herein are intended to include all such embodiments.

The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although a few exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention. Therefore, it is to be understood that the foregoing is illustrative of the present invention and is not to be construed as limited to the specific embodiments disclosed, and that modifications to the disclosed embodiments, as well as other embodiments, are intended to be included within the scope of the invention.